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Forest Insect & Disease Management
Pacific Northwest Region

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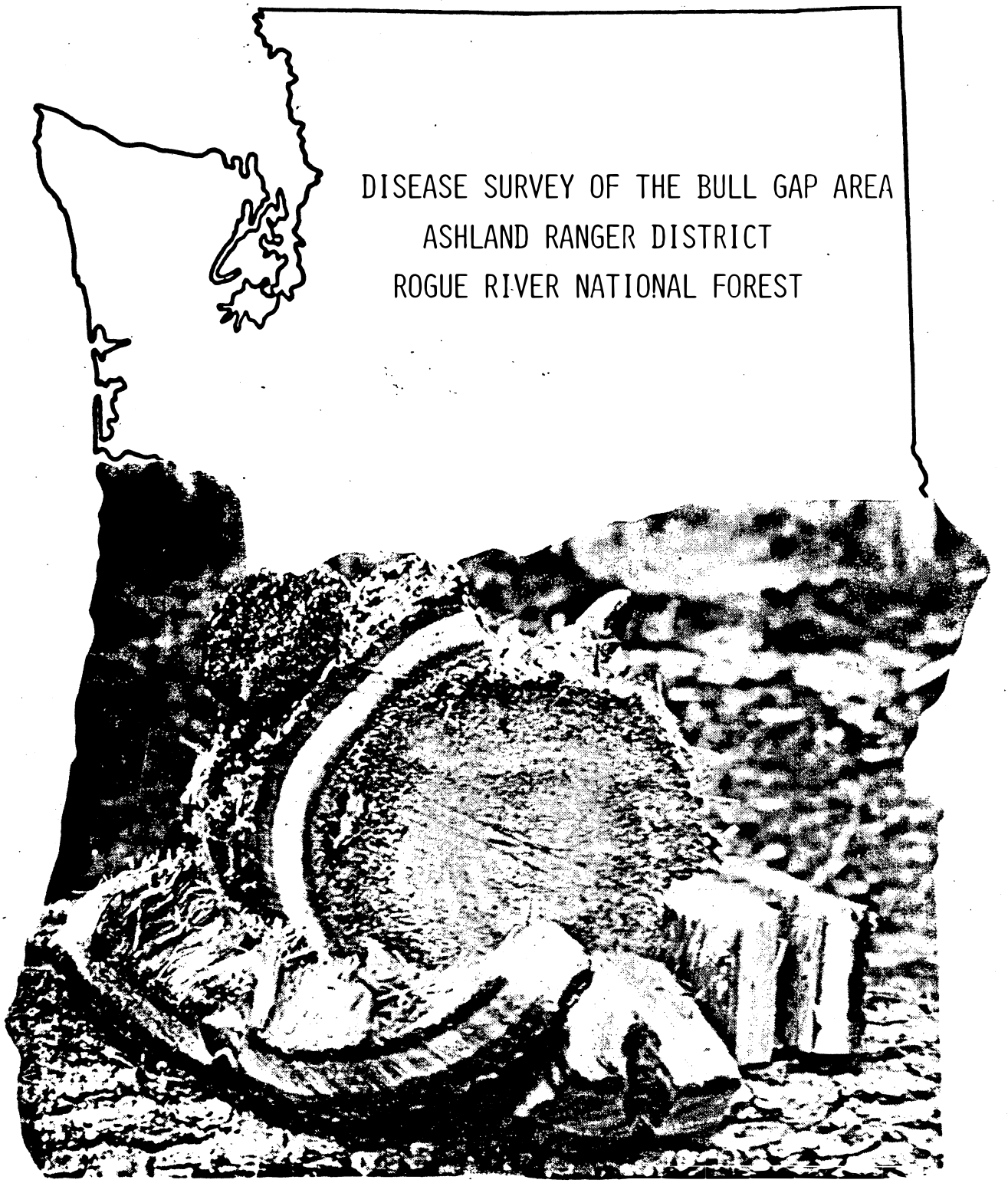

DISEASE SURVEY OF THE BULL GAP AREA
ASHLAND RANGER DISTRICT
ROGUE RIVER NATIONAL FOREST

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September 1980

DISEASE SURVEY OF THE BULL GAP AREA, ASHLAND RANGER DISTRICT, ROGUE RIVER NATIONAL FOREST

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INTRODUCTION

During the weeks of June 3-12, 1980, a disease survey was done by a Forest Insect and Disease Management pathology crew in the Bull Gap area, Ashland Ranger District, Rogue River National Forest. The unit surveyed was in T. 40 S., R. 1 E., sec. 14, 15, and 22 (Figure 1). District personnel previously had identified laminated root rot (caused by the fungus *Phellinus (Poria) weirii*) in the area and had observed on aerial photographs considerable evidence of stand deterioration which they suspected might be caused by the disease. They requested an evaluation to determine distribution and intensity of laminated root rot and other diseases in the stand and provide recommendations for disease management.

METHODS

Approximately 800 acres were surveyed systematically using a variable plot method. A 40-factor basal area prism was used to define each plot. Plots were located at 10-chain intervals along lines 10 chains apart across the stand. All trees within each prism plot were examined, and the following information was recorded: tree species, DBH, general condition (live, dead, standing, or down), and presence of disease. Two roots on opposite sides of each plot tree were excavated to a distance of 3 feet from the root collar and examined for evidence of root disease. Butts and roots of dead trees were dissected to determine the character of wood decay. Signs and symptoms of heartrot, including conks or large wounds, were recorded for each tree. Crowns of all trees were examined for signs and symptoms of other diseases such as dwarf mistletoes and rusts. From the data collected in each prism plot, mean basal area, number of trees, and volume per acre were calculated by tree species, DBH class, and disease condition using the Region 6 V-plot computer program.

In addition to the variable plot, a .01-acre fixed-area plot was established at each plot center to assess disease occurrence and severity in trees too small to be included in the prism sample. In these plots, all trees greater than 6 inches tall but less than 5 inches DBH were examined in the same manner as were prism plot trees.

In order to obtain more complete information on disease distribution, an additional set of prism plots was established at 2-chain intervals along the survey lines. Presence of any diseases on trees in these plots was recorded, but no individual tree measurements or data were taken. Information from these disease incidence plots and the volume plots was used in combination to prepare disease distribution maps.

RESULTS AND DISCUSSION

The stand surveyed was composed predominantly of white fir (*Abies concolor*) and Douglas-fir (*Pseudotsuga menziesii*) with lesser components of incense cedar (*Libocedrus decurrens*), ponderosa pine (*Pinus ponderosa*), sugar pine (*P. lambertiana*), western white pine (*P. monticola*), and red fir (*A. magnifica*). Douglas-firs and pines tended to be large, old trees, while white fir, red fir, and incense cedar occurred both as old growth and young, understory trees. Mean numbers of trees, basal areas, and volumes per acre by tree species and DBH class are summarized in Tables 1, 2, and 3.

The stand has been experiencing substantial amounts of tree mortality for a number of years. Currently, 13 percent of all trees containing 21 percent of all volume are dead. Mean number of trees per acre, basal area per acre, and board foot volume per acre by tree condition are presented in Tables 4, 5, and 6. Most dead trees are not salvageable. White fir is suffering the greatest amount of mortality (69 percent of all dead trees) with Douglas-fir second (24 percent of all dead trees). Other species exhibit little mortality. As noted by the District, mortality tends to occur in patches.

Most tree mortality is associated with disease. However, contrary to expectations, relatively little is associated with laminated root rot. Rather, most seem to involve a group of diseases that commonly cause decline and death in overmature trees: dwarf mistletoes, heart rots, and Armillaria root rot. Tables 7, 8, and 9 present mean number of trees, basal area, and volume per acre infected by the various pathogens encountered in the survey, and Figures 2-7 show their distributions in the stand. The following is a more detailed examination of each disease.

Dwarf Mistletoes - Dwarf mistletoes of white fir (*Arceuthobium abietinum* f. sp. *concoloris*), red fir (*A. abietinum* f. sp. *magnificae*), and Douglas-fir (*A. douglasii*) were the most commonly encountered pathogens in the survey area. Forty-two percent of all white firs, 50 percent of the red firs, and 45 percent of the Douglas-fir examined were infected. Trees of all size classes exhibited infection. Distribution of infection was as shown in Figures 2, 3, and 4.

Effects of dwarf mistletoe differ with degree and location of infection, host and mistletoe species, and host vigor. In young, vigorous white and red firs, effects are normally minor. However, in heavily infected firs, especially older trees with numerous infections in the upper portions of the crown, the disease can cause significant decline and may contribute to tree death. This situation was common in the survey area. Much of the mortality in old-growth white fir was associated with heavy dwarf mistletoe infection combined with heart rots.

Dwarf mistletoe infection in Douglas-fir results in formation of large witches' brooms (Figure 10), causing crown distortion and loss of tree vigor. Heavy infection causes considerable growth loss, frequent top killing, and commonly contributes to tree death, especially in older trees. Twelve percent of the Douglas-fir mortality in the survey area was associated with dwarf mistletoe infection alone.

Heart Rots - Heart rots of old-growth white fir were common in the survey area. Sixty percent of the dead white firs had heart rots caused by several fungi alone or in combination, including *Echinodontium tinctorium* (Figure 11), *Fomes annosus, Phellinus pini,* and *Pholiota adiposa*. Many living trees also showed evidence of infection. Most of the trees affected were large. Heart-rotted white firs were distributed throughout the survey area (Figure 5).

True firs, as non-resinous, relatively thin-barked conifer species, are highly susceptible to infection by heart rot organisms. Trees are especially likely to exhibit decay as they reach ages in excess of 120 years. Decay pathogens normally enter the hosts through wounds or dead branches. *Echinodontium tinctorium*, the most common decay organism in the survey area,

enters its hosts through small dead branchlets and is later activated by wounding to cause large decay columns. In the survey area, heart-rotted white firs frequently were found broken off at heights of 5 to 20 feet.

Brown cubical rot, caused by *Phaeolus schwenitzii*, was observed in 24 percent of the dead Douglas-fir in the survey area. This disease usually causes damage only in large, old trees. In the survey area, it was seen in large, broken-off stubs or snags. The fungus is believed to enter hosts through fire scars and takes many years to develop a decay column.

Armillaria Root Rot - Armillaria root rot, caused by *Armillaria mellea*, was found on 19 percent of the dead white fir and 16 percent of the dead Douglas fir (Figure 12). The disease was found mostly in fairly large trees. Distribution of Armillaria root rot was as shown in Figure 6.

Armillaria mellea survives as a saprophyte in old stumps and roots and infects nearby trees across root contacts or by growing short distances through the soil. On the west side of the Cascade Mountains, *A. mellea* is generally a weak pathogen that affects stressed or injured trees. Most dying trees with *A. mellea* in the survey area were unthrifty and overmature. Many also had heavy dwarf mistletoe infections and/or other diseases.

Laminated Root Rot - Though not as prominent or widely distributed in the survey area as was originally feared, *P. weirii* was found in 16 percent of the dead Douglas-fir and 6 percent of the dead white fir (Figure 13). Distribution was spotty and most laminated root rot centers seemed to occur in low-lying creek bottom areas (Figure 7).

Phellinus weirii is a particularly dangerous pathogen because it is persistent on the site. It can survive for long time periods (50 years or more) in old stumps and roots. The fungus spreads to new hosts via root contacts and infects trees of all vigor classes. It spreads at a rate of about one foot a year. Trees are killed outright or are windthrown after roots are decayed (Figure 14).

Rust Diseases - Several rust diseases were encountered in the survey area. White pine blister rust, caused by the fungus *Cronartium ribicola* was observed mainly causing branch kill in large sugar pines. Distribution of the disease was as shown in Figure 8. The white pine blister rust fungus is an introduced pathogen with a complex life cycle. The fungus requires two hosts, five-needle pines and members of the genus *Ribes*. It commonly causes death of the pine host if the stem becomes infected (Figure 15). Though not too important in the survey stand now, this could be a damaging disease if the stand or portions of it were harvested and regenerated with non-blister-rust-resistant five-needle pines.

Incense cedar rust caused by *Gymnosporangium libocedri* was observed forming witches' brooms (Figure 16) and causing some foliage necrosis in large incense cedars. Distribution in the stand was as shown in Figure 9. This is a minor disease that at most may cause a small amount of growth loss.

Fir broom rust, caused by *Melampsorella caryophyllacearum*, was observed on a few large white fir at the extreme west border of the survey unit. This disease too may cause some growth loss.

MANAGEMENT RECOMMENDATIONS

Basically, our survey has revealed an overmature, mixed-conifer stand with a heavy true fir component, suffering from many of the disease problems commonly encountered in such stands. The best control for most of the disease problems will be attained by properly harvesting the current stand and managing future stands at some reasonable rotation. We make the following recommendations:

(1) Treatment Priorities

The survey area is a large unit that will undoubtedly require careful planning and considerable time to harvest and bring under management. In determining which portions of the unit should be treated first, we offer the following priority based on likelihood of continued loss: (a) concentrate first efforts in portions of the stand predominated by white fir since this species is most subject to loss, (b) red fir is a close second, (c) Douglas-fir should stand up better but is definitely third, (d) pines and incense cedars are most resistant to disease loss and can be retained until last. If managers desire to maintain parts of this stand in old growth, we strongly recommend that they choose areas with pine and/or incense cedar.

(2) Harvesting and Regeneration Methods

A. The best method of harvesting the stand from the point of view of disease control would be patch clear-cutting. This would be especially effective in controlling dwarf mistletoes. If this method can be employed, be sure to (1) make clean clearcuts with all mistletoe-infected trees removed and (2) lay out units with mistletoe-free boundaries to prevent reinvasion from the margins. In regenerating clearcuts, any species adapted to the site can be planted. In some areas around the survey unit, attempts to replant clearcut units with Douglas-fir have been almost totally unsuccessful. Apparently, on some aspects and soil types, especially if there is cold air drainage or a frost pocket, true firs are much better species to plant. From a disease point of view, there is no reason why true firs should not be replanted on clearcuts in the Bull Gap area unless there is laminated root rot present.

B. The second choice of a harvesting-regeneration system would be a seed tree or shelterwood method. If mistletoe-infected true firs or Douglas-firs must be used as seed or shelter trees, remove them before the regeneration reaches a height of 3 feet or age of 10 years. For greatest safety, mistletoe-free or nonsusceptible trees should be preferred for seed trees. If sugar pines or white pines are to be used as seed trees, choose individuals which exhibit phenotypic resistance to white pine blister rust.

C. A third choice of a harvesting-regeneration method would be an overstory removal with retention of the understory. Because of the heavy dwarf mistletoe infection in the understory fir, this method should be approached with caution. If this method is used, favor by order of priority in the understory: (1) tree species not susceptible to mistletoe, (2) dominant and codominant true fir and Douglas-fir with no apparent mistletoe infections, (3) dominant and codominant true fir with mistletoe infections limited to the lower third of the crown, (4) dominant and codominant true fir with less than half of the branches in the bottom half of the crown infected by mistletoe,

and (5) intermediate true fir with no apparent dwarf mistletoe infections. Douglas-fir dwarf mistletoe is especially damaging. Infected Douglas-firs should not be selected as leave trees if more than 15 years would be necessary for a comparable-sized but uninfected tree to reach merchantability. Under no circumstance should true firs or especially Douglas-firs with dwarf mistletoe infections in the upper one-third of the crown be maintained as crop trees. The same priorities should be used in subsequent thinning treatments of the stand. Development of decay by *Echinodontium tinctorium* may also be a hazard if suppressed white fir understories are retained.

(3) Future Rotations

To maximize timber production and minimize disease-caused losses in the survey area, we recommend that future rotations on this unit be not more than 125 years for true firs and Douglas-firs and not more than 150 years for pine and incense cedars.

(4) Special Considerations

A. Laminated Root Rot Control - Areas in which laminated root rot were found in this survey should receive special treatment because of the persistent nature of the pathogen and the devastating effect it has on susceptible hosts. In laying out units for harvest in this stand, laminated root rot centers should be delineated. Then, these areas and a 50-foot buffer around each should be treated in one of the following ways: (1) following or during harvest, physically remove all inoculum sources. Push or pull all stumps out of the ground with heavy equipment. Break up as many as possible of the roots not removed from the soil. Replant with any species suitable for the site; (2) following harvest, do not remove stumps, but replant the site with tree species that are immune (hardwoods) or resistant (pines and incense cedar) to the disease. Keep susceptible tree species (Douglas-fir and true fir) off of the site, or (3) use root rot infection centers for some other use than timber production (i.e., wildlife areas, scenic areas, etc.). Keep susceptible hosts from growing around the margins of infection centers to prevent spread into the surrounding stand. Alternative (2), species manipulation, is probably the most realistic and usable alternative for the Bull Gap area.

B. Five-Needle Pine Planting Stock - If it is decided to plant any portions of the Bull Gap unit with sugar pine or western white pine, use material that has been screened for white pine blister rust resistance through the Dorena Project.

C. Armillaria Root Rot Prevention - When planting any tree species in the Bull Gap area, use local seed source stock and concentrate on quality planting to prevent Armillaria root rot damage. Avoid planting true fir in any areas with concentrated Armillaria root rot.

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FIGURE CAPTIONS

Figure 1: Location of Bull Gap survey area.

Figure 2: Distribution of white fir dwarf mistletoe in Bull Gap survey area.

Figure 3: Distribution of red fir dwarf mistletoe in Bull Gap survey area.

Figure 4: Distribution of Douglas-fir dwarf mistletoe in Bull Gap survey area.

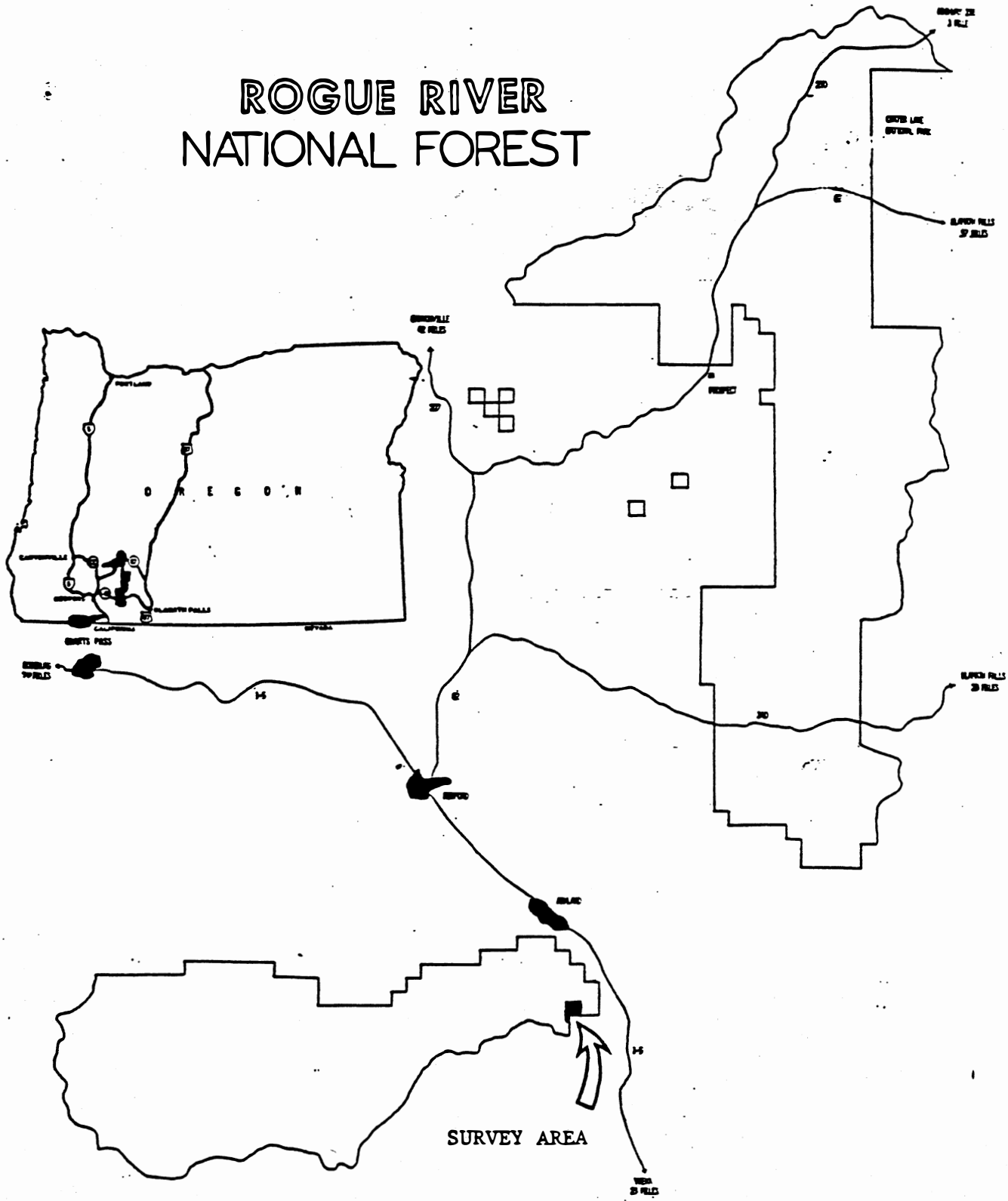
Figure 5: Distribution of decay organisms, *Echinodontium tinctorium, Fomes annosus, Phellinus pini, Pholiota adiposa,* and *Phaeolus schweinitzii*, in Bull Gap survey area.

Figure 6: Distribution of Armillaria root rot in Bull Gap survey area.

Figure 7: Distribution of laminated root rot in Bull Gap survey area.

Figure 8: Distribution of white pine blister rust in Bull Gap survey area.

Figure 9: Distribution of incense cedar rust in Bull Gap survey area.


ROGUE RIVER
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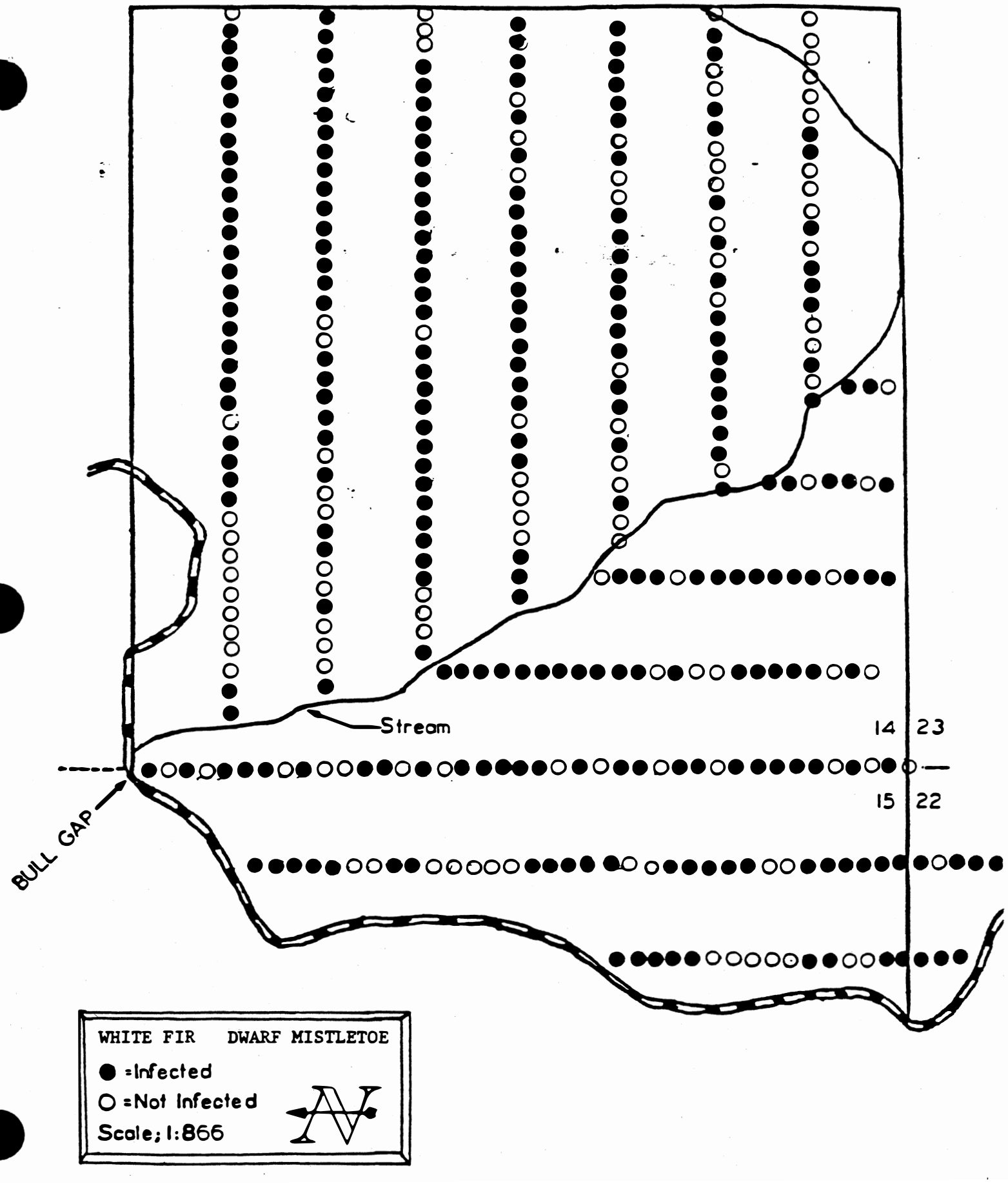
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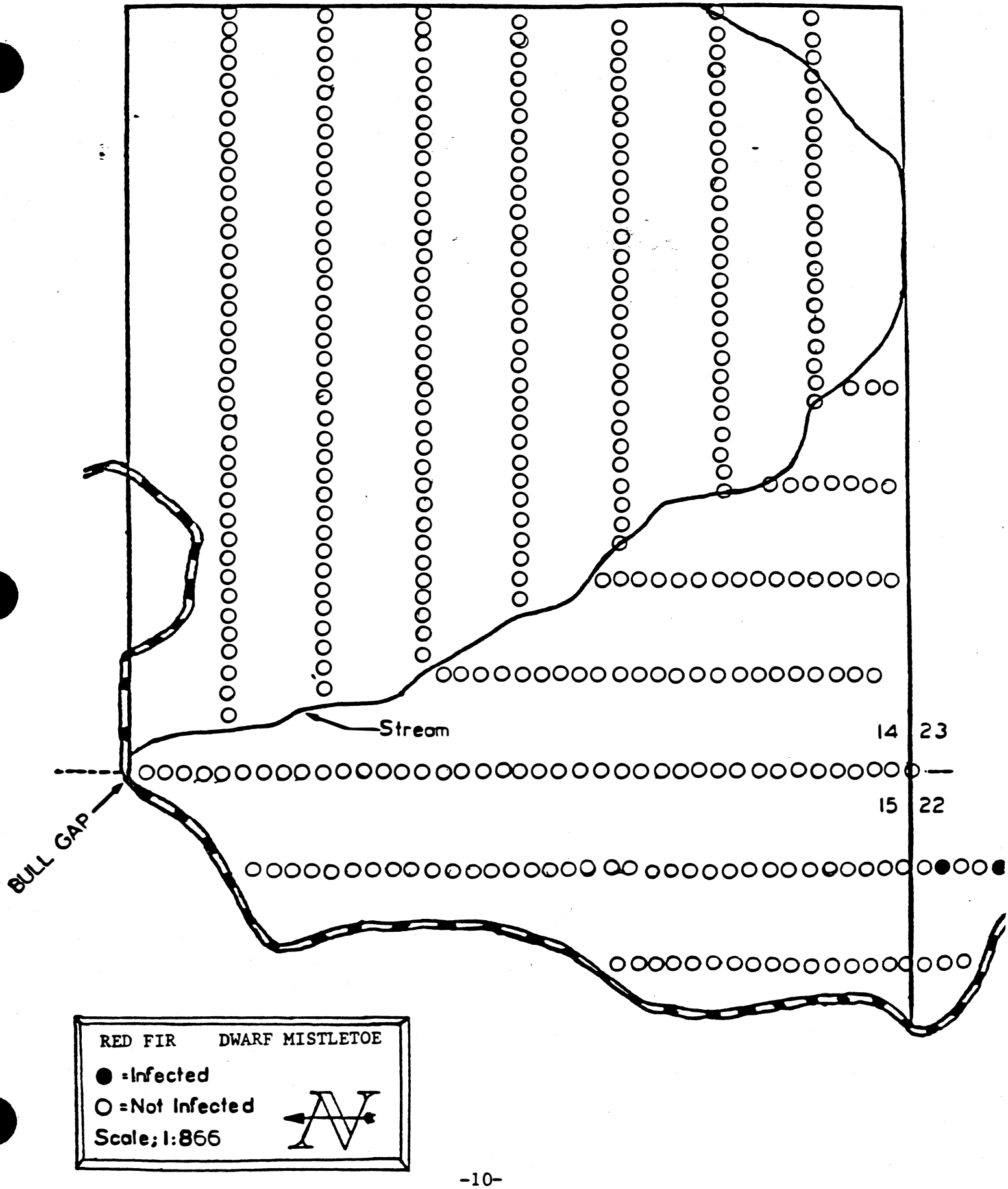
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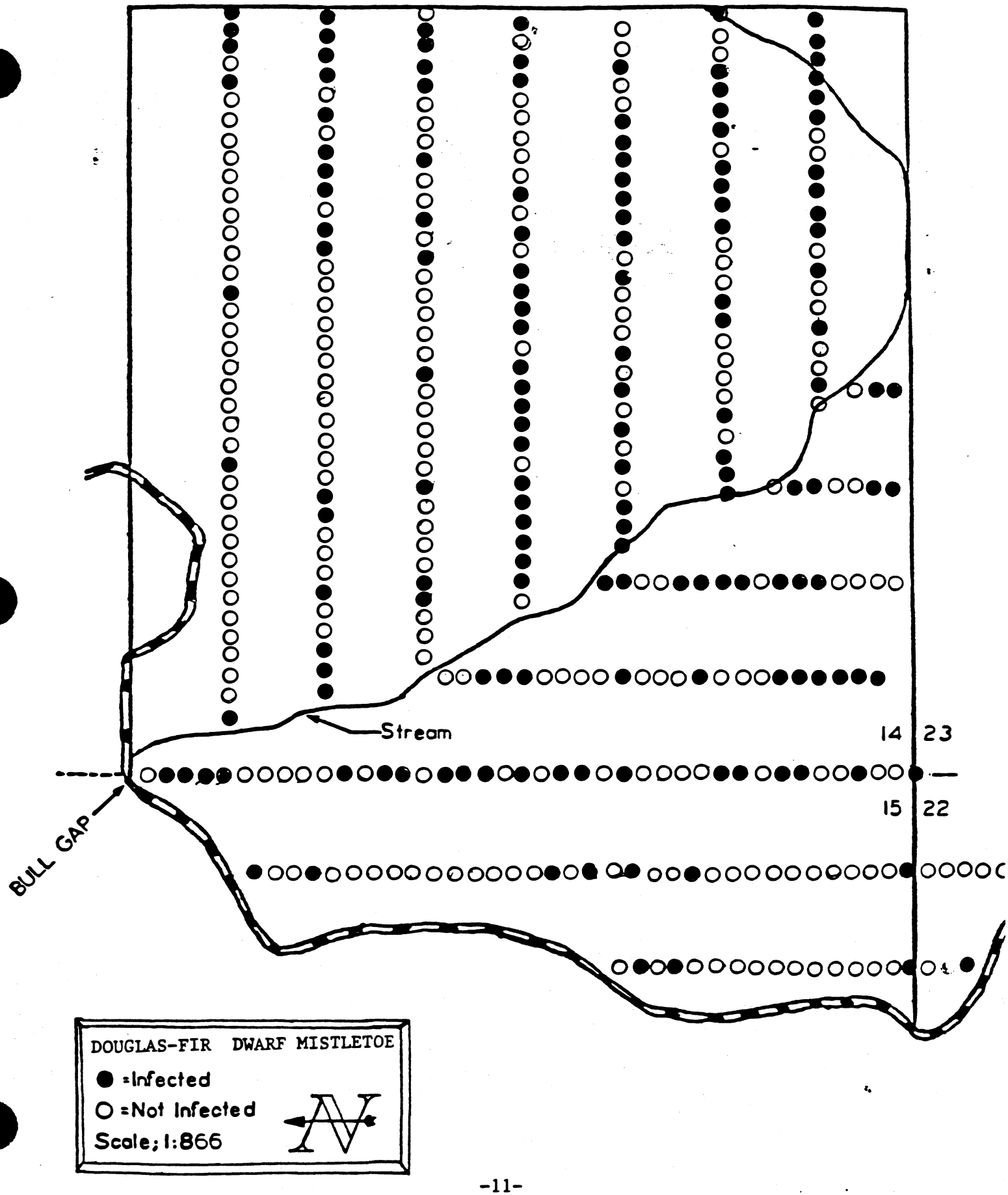
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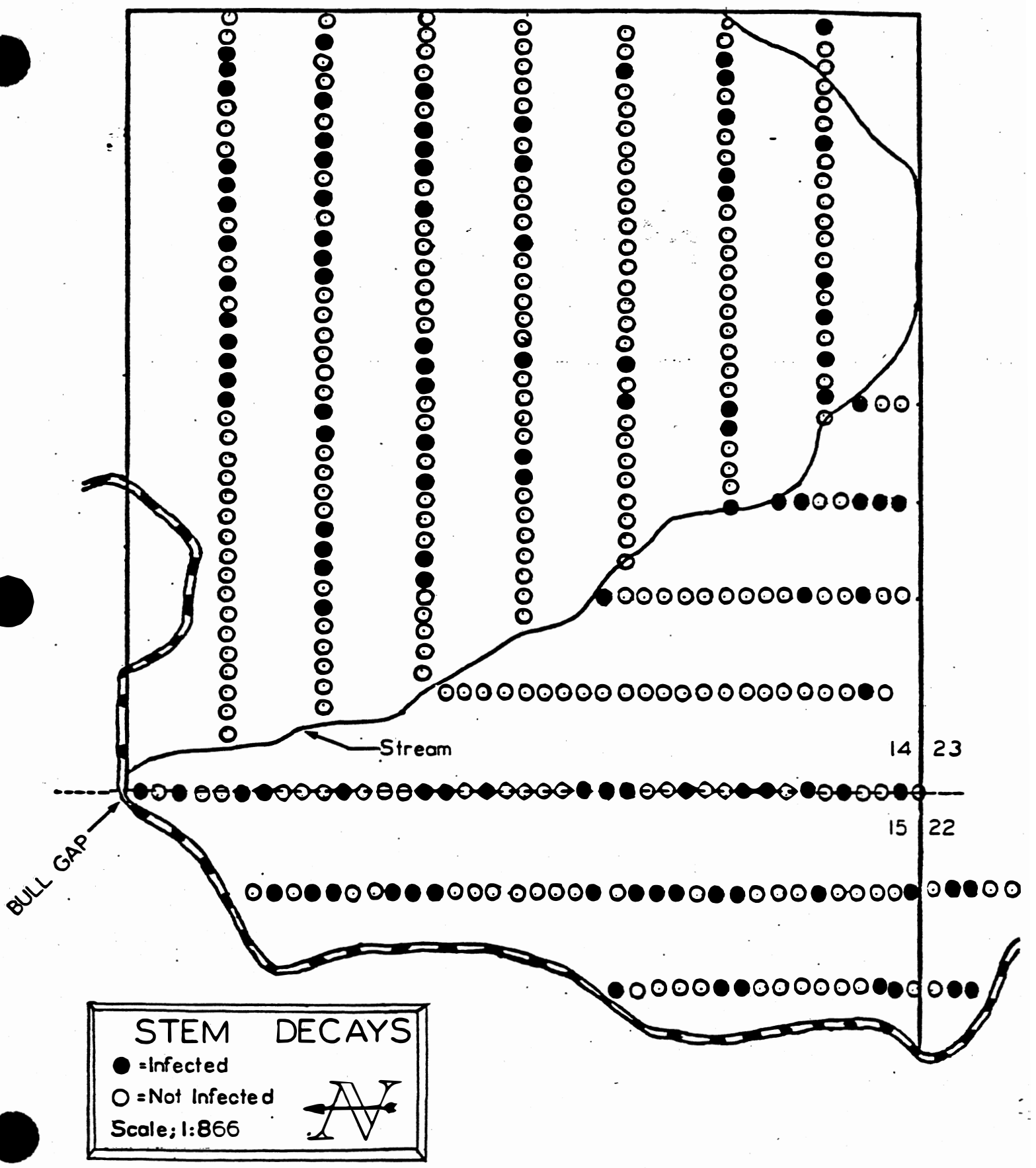
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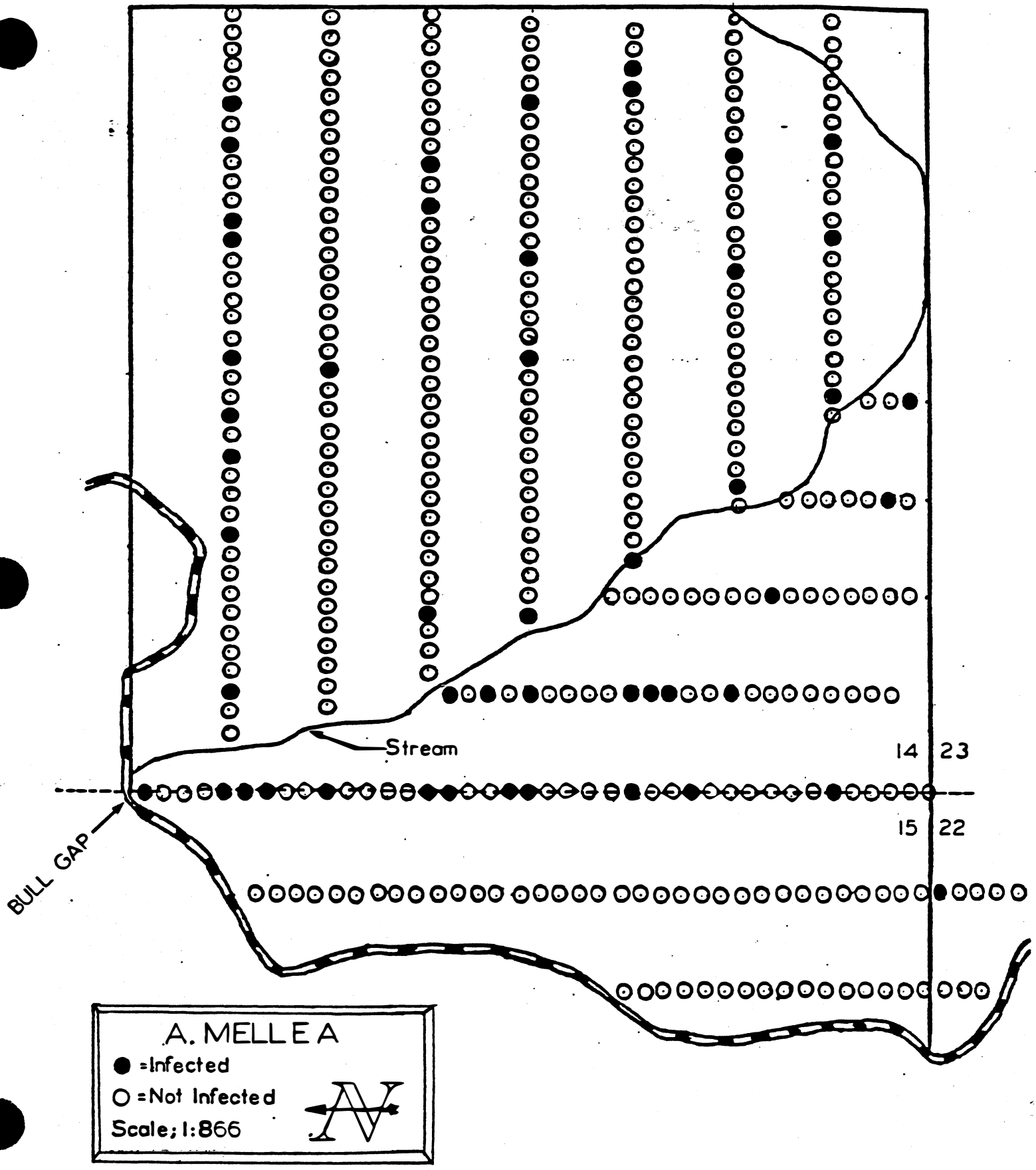
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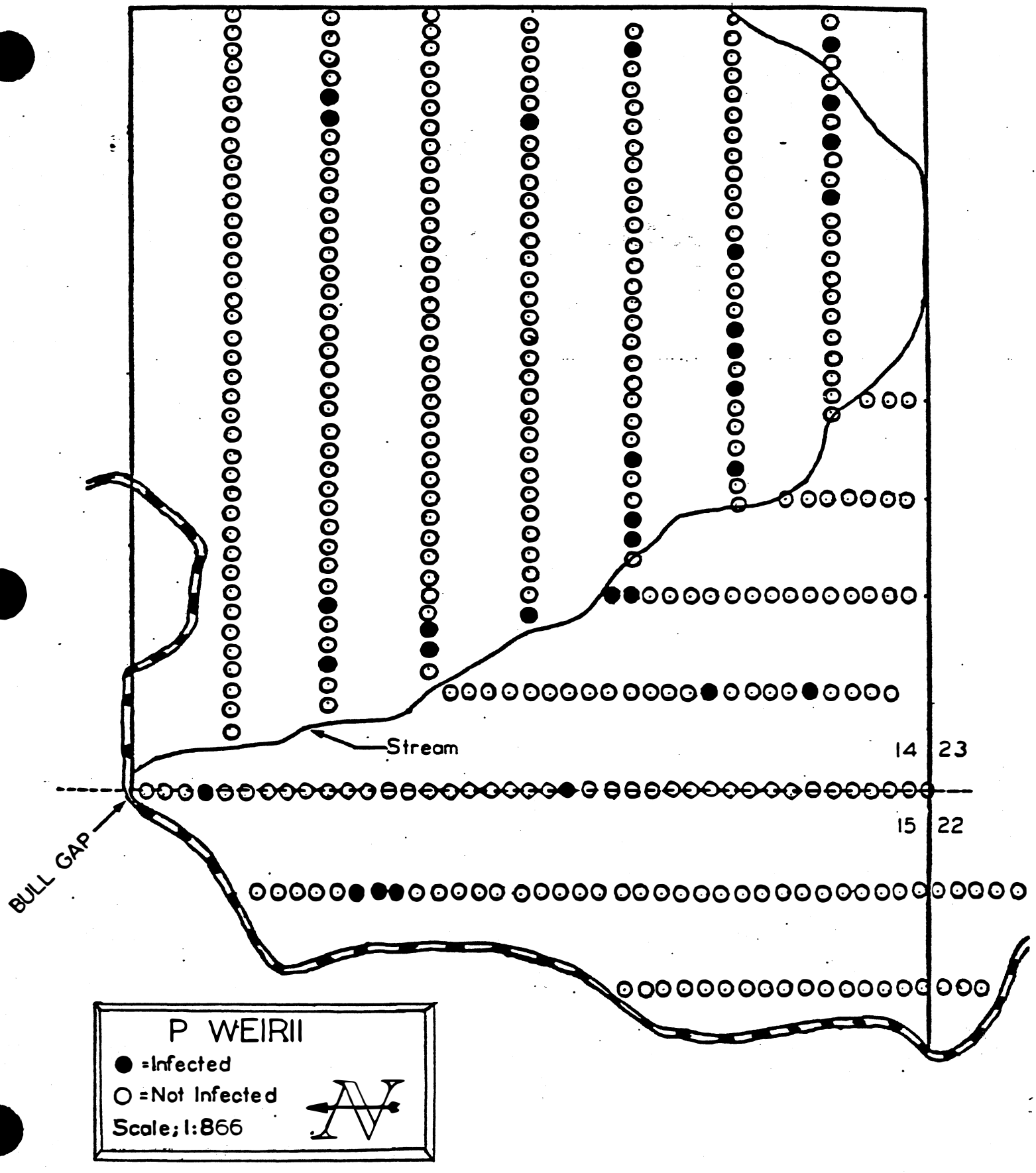
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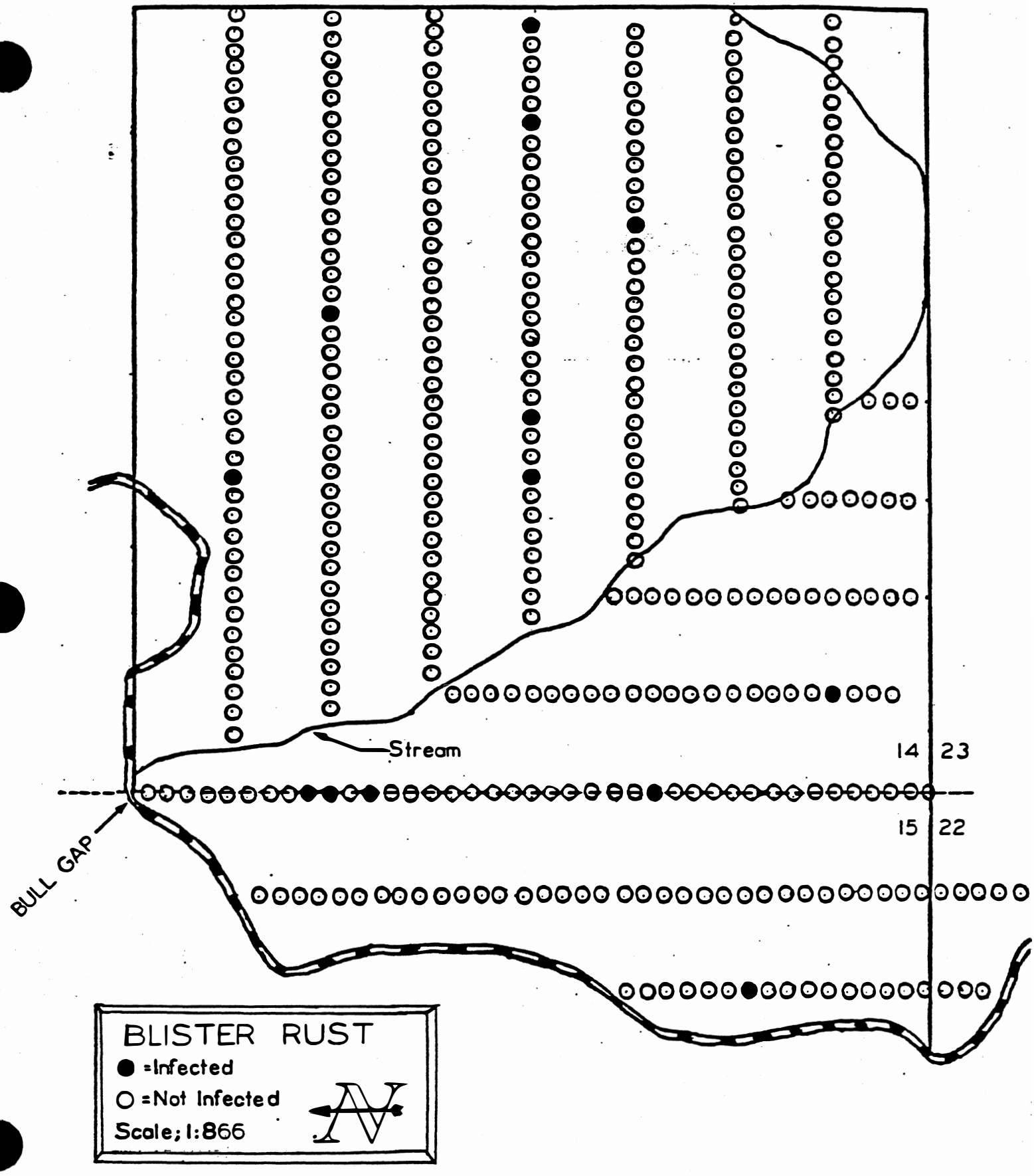
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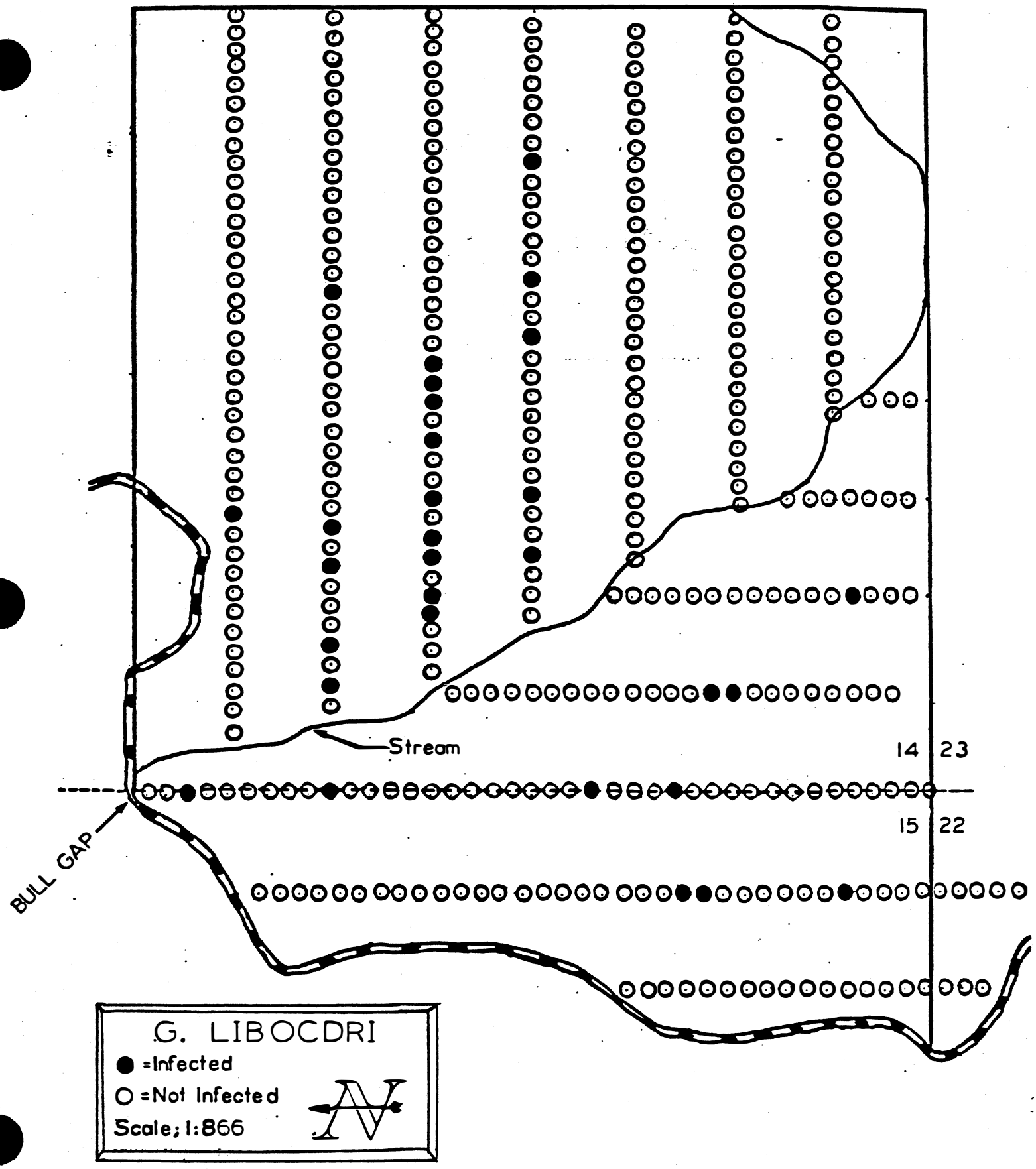
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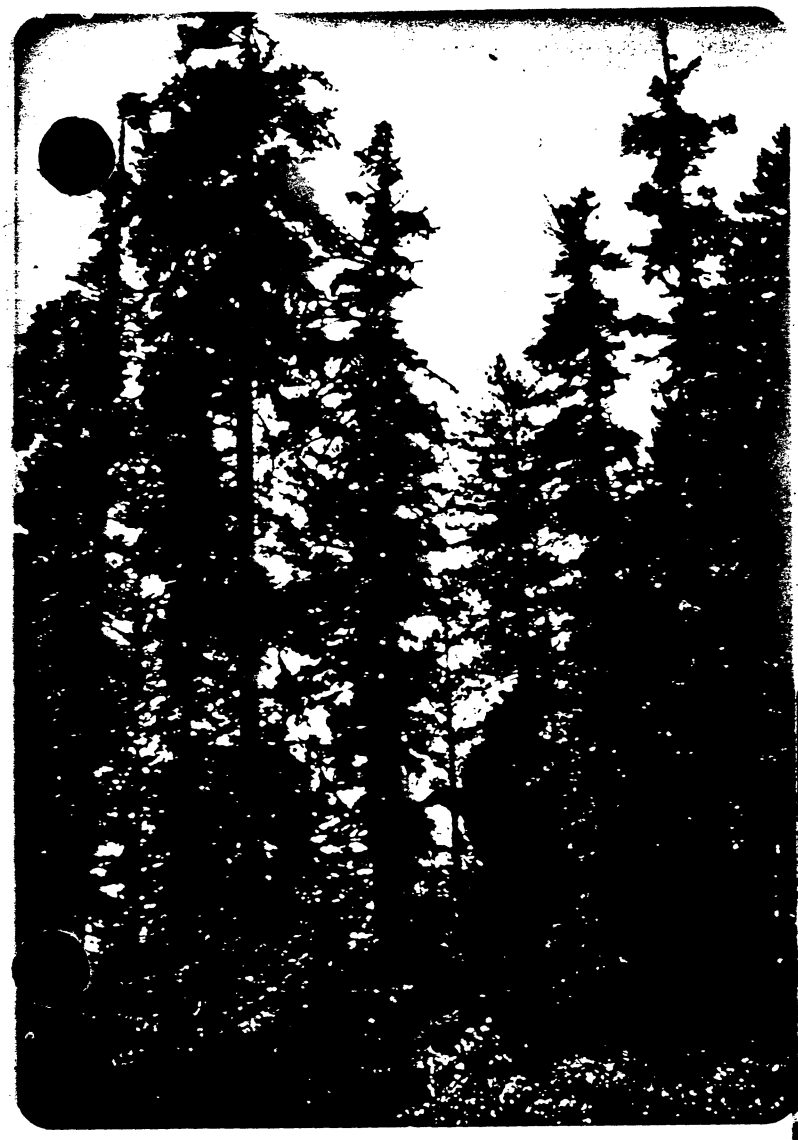

Figure 10. Douglas-fir in the Bull Gap survey area infected by dwarf mistletoe exhibit witches' brooms, crown deterioration and top-kill

Figure 11: Conks of the Indian paint fungus, *Echinodontium tinctorium* on a white fir in the Bull Gap survey area. Presence of these conks usually indicates extensive decay and was commonly associated with trunk breakage in the survey area.

Figure 12: Mycelium of *Armillaria mellea* under bark of dying tree in the Bull Gap survey area.

Figure 13: Typical laminated decay caused by *Phellinus weirii* in Bull Gap area. Reddish, whiskery setal hyphae between layers of decayed wood are diagnostic for this organism.

Figure 14: Typical wind-thrown tree with roots rotted off to form a "root ball" by *Phellinus weirii*

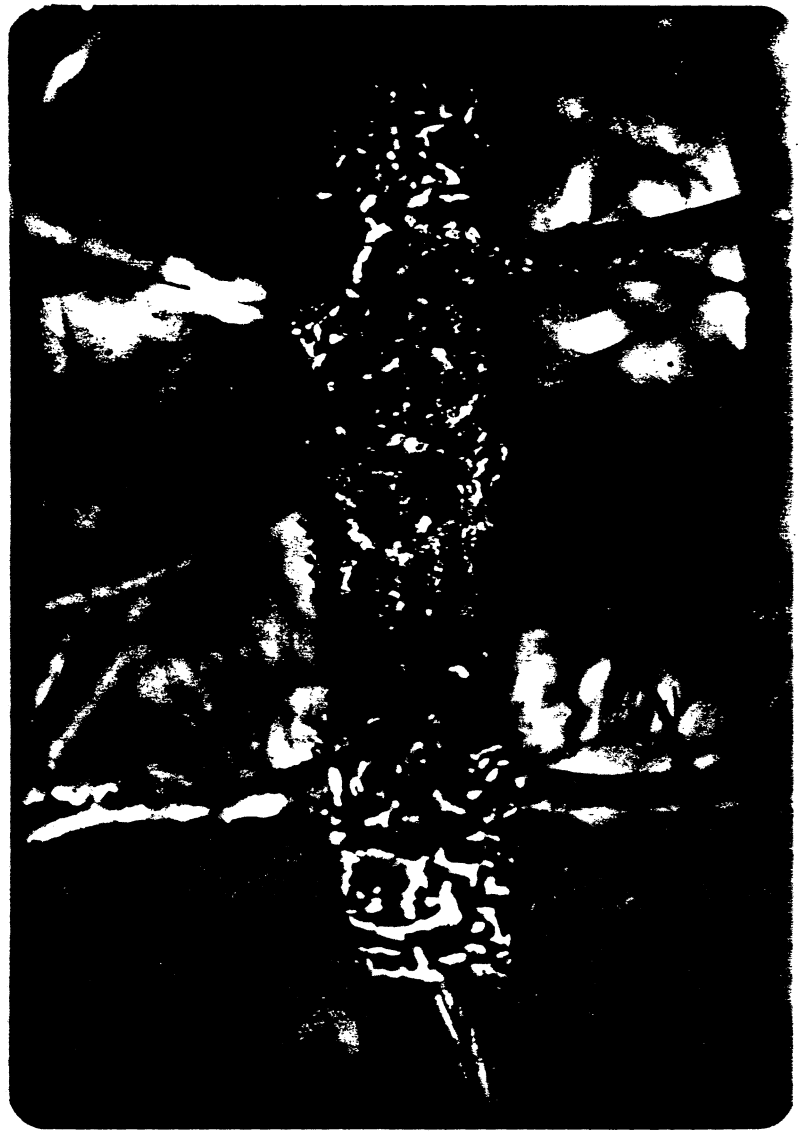

Figure 15: White pine blister rust infection on the main stem causing host mortality. The yellowish aeciospores shown here are dispersed by wind and infect *Ribes*

Figure 16: Incense cedar rust sporulating in witches' broom, Bull Gap survey area.

Table 1.--Mean number of trees per acre by species, Bull Gap survey area

DIAMETER CLASS	WHITE FIR	DOUGLAS FIR	PONDEROSA PINE	SUGAR & WHITE PINE	INCENSE CEDAR	RED FIR	TOTAL ALL CLASSES
6	78.1	2.8	.0	.0	.0	.0	80.9
8	26.7	3.1	.0	.0	1.6	.0	31.4
10	18.1	2.0	.0	.0	.0	.0	20.1
12	7.7	1.4	.0	.0	.0	.0	9.1
14	7.2	1.5	.0	.0	.0	.0	8.7
16	5.1	2.4	.0	.0	.0	.0	7.5
18	6.2	2.5	.3	.0	.3	.0	9.3
20	2.8	1.3	.0	.3	.0	.0	4.4
22	3.7	.8	.2	.0	.6	.0	5.3
24	3.3	1.0	.0	.0	.0	.0	4.3
26	3.3	.6	.0	.0	.3	.2	4.4
28	3.3	.5	.0	.0	.1	.1	4.0
30	1.3	.8	.0	.0	.0	.1	2.2
32	1.3	.3	.2	.0	.0	.0	1.8
34	1.0	.9	.0	.1	.3	.0	2.3
36	.9	.3	.0	.1	.1	.0	1.4
38	.6	.3	.1	.1	.1	.1	1.3
40	.4	.3	.0	.2	.0	.0	.9
42	.3	.1	.1	.1	.1	.0	.7
44	.1	.2	.1	.0	.0	.0	.4
46	.3	.2	.0	.2	.0	.0	.7
48	.2	.1	.0	.0	.0	.0	.3
50	.1	.0	.0	.1	.0	.0	.2
52	.1	.1	.0	.1	.0	.0	.3
54	.0	.0	.0	.1	.0	.0	.1
56	.0	.1	.0	.0	.0	.0	.1
58	.1	.0	.0	.1	.0	.0	.2
60+	.0	.2	.0	.1	.0	.0	.3
Total	172.2	23.8	1.0	1.6	3.5	.5	202.6
Percent	85.0	11.8	0.5	0.8	1.7	0.2	100.0

Table 2.--Mean basal area per acre (ft^2) by species, Bull Gap survey area

DIAMETER CLASS	WHITE FIR	DOUGLAS FIR	PONDEROSA PINE	SUGAR & WHITE PINE	INCENSE CEDAR	RED FIR	TOTAL ALL CLASSES
6	15.3	.5	.0	.0	.0	.0	15.8
8	9.3	1.1	.0	.0	0.5	.0	10.9
10	9.9	1.1	.0	.0	.0	.0	11.0
12	6.0	1.1	.0	.0	.0	.0	7.1
14	7.7	1.6	.0	.0	.0	.0	9.3
16	7.1	3.3	.0	.0	.0	.0	10.4
18	11.0	4.4	.5	.0	.5	.0	16.4
20	6.0	2.7	.0	.5	.0	.0	9.2
22	9.9	2.2	.5	.0	1.6	.0	14.2
24	10.4	3.3	.0	.0	.0	.0	13.7
26	12.1	2.2	.0	.0	1.1	.8	16.2
28	14.2	2.2	.0	.0	.5	.5	17.4
30	6.6	3.8	.0	.0	.0	.5	10.9
32	7.1	1.6	1.1	.0	.0	.0	9.8
34	6.0	5.8	.0	.5	2.7	.0	15.0
36	6.0	2.2	.0	.5	.5	.0	9.2
38	4.4	2.2	.5	.5	.5	.5	8.6
40	3.3	2.7	.0	1.6	.0	.0	7.6
42	3.3	1.1	1.1	.5	1.1	.0	7.1
44	1.1	2.2	.5	.0	.0	.0	3.8
46	3.3	2.2	.0	3.2	.5	.0	9.2
48	2.2	1.6	.0	.0	.0	.0	3.8
50	1.6	.5	.5	1.6	.5	.5	5.2
52	1.6	1.1	.0	2.2	.0	.0	4.9
54	.5	.0	.5	1.6	.5	.0	3.1
56	.5	1.6	.0	.5	.5	.0	3.1
58	1.1	.0	.0	1.1	.0	.0	2.2
60+	.5	3.3	.5	2.7	.0	.5	7.5
Total	168.0	57.6	5.7	17.0	11.0	3.3	262.6
Percent	64.0	21.9	2.2	6.5	4.1	1.3	100.0

Table 3.--Mean volume per acre (Mbdft) by species, Bull Gap survey area

DIAMETER CLASS	WHITE FIR	DOUGLAS FIR	PONDEROSA PINE	SUGAR & WHITE PINE	INCENSE CEDAR	RED FIR	TOTAL ALL CLASSES
8	.4270	.0502	.0000	.0000	.0251	.0000	.5023
10	.6510	.0723	.0000	.0000	.0000	.0000	.7233
12	.5832	.1060	.0000	.0000	.0000	.0000	.6892
14	.9616	.2061	.0000	.0000	.0000	.0000	1.1677
16	1.0918	.5039	.0000	.0000	.0000	.0000	1.5957
18	1.9969	.7988	.0998	.0000	.0998	.0000	2.9953
20	1.1327	.5149	.0000	.1030	.0000	.0000	1.7506
22	1.9391	.4309	.1077	.0000	.3232	.0000	2.8009
24	2.2601	.7137	.0000	.0000	.0000	.0000	2.9738
26	2.8380	.5160	.0000	.0000	.2580	.1290	3.7410
28	3.6182	.5567	.0000	.0000	.1392	.1392	4.4533
30	1.7186	1.0025	.0000	.0000	.0000	.1432	2.8643
32	1.9068	.4400	.2933	.0000	.0000	.0000	2.6401
34	1.7380	1.5797	.0000	.1580	.6320	.0000	4.1077
36	1.8751	.6819	.0000	.1705	.1705	.0000	2.8980
38	1.3781	.6891	.1723	.1723	.1723	.1723	2.7564
40	1.0466	.8722	.0000	.5233	.0000	.0000	2.4421
42	1.1225	.3742	.3743	.1871	.3742	.0000	2.4323
44	.4029	.8058	.2014	.0000	.0000	.0000	1.4101
46	1.2862	.8575	.0000	1.0718	.2144	.0000	3.4299
48	.8733	.6550	.0000	.0000	.0000	.0000	1.5283
50	.6697	.2232	.2232	.6697	.2232	.2232	2.2322
52	.7054	.4703	.0000	.9406	.0000	.0000	2.1163
54	.2516	.0000	.2516	.7549	.2516	.0000	1.5097
56	.2460	.7381	.0000	.2460	.2460	.0000	1.4761
58	.5238	.0000	.0000	.5238	.0000	.0000	1.0476
60+	.2625	1.5748	.2625	1.3123	.0000	.2624	3.6745
Total	33.5067	15.4338	1.9861	6.8333	3.1295	1.0693	61.9587
Percent	54.1	24.9	3.2	11.0	5.1	1.7	100.0

Table 4.—Mean number of trees per acre by condition, Bull Gap survey area

DIAMETER CLASS	LIVE STANDING	SNAG	STUB	STUMP	RECENT KILL	DEAD DOWN	TOTAL ALL CLASSES
6	72.6	2.8	2.8	.0	.0	2.8	81.0
8	25.1	.0	3.1	.0	.0	3.1	31.3
10	20.1	.0	.0	.0	.0	.0	20.1
12	9.1	.0	.0	.0	.0	.0	9.1
14	7.2	1.0	.5	.0	.0	.0	8.7
16	7.5	.0	.0	.0	.0	.0	7.5
18	7.1	.3	.3	.6	.0	.9	9.2
20	4.0	.0	.3	.0	.0	.0	4.3
22	5.0	.0	.4	.0	.0	.0	5.4
24	4.0	.2	.2	.0	.0	.0	4.4
26	3.4	.3	.3	.3	.0	.0	4.3
28	2.8	.4	.4	.3	.0	.3	4.2
30	1.7	.1	.1	.3	.0	.0	2.2
32	1.5	.2	.0	.1	.0	.0	1.8
34	1.7	.3	.1	.1	.1	.1	2.4
36	1.1	.2	.0	.0	.0	.1	1.4
38	.8	.1	.1	.1	.0	.0	1.1
40	.6	.0	.2	.1	.0	.0	.9
42	.5	.1	.1	.1	.0	.0	.8
44	.2	.1	.1	.0	.0	.0	.4
46	.7	.0	.0	.0	.0	.0	.7
48	.1	.0	.1	.0	.0	.0	.2
50	.4	.0	.0	.0	.0	.0	.4
52	.3	.0	.0	.0	.0	.0	.3
54	.1	.1	.0	.0	.0	.0	.2
56	.1	.0	.0	.0	.0	.0	.1
58	.1	.0	.0	.0	.0	.0	.1
60+	.3	.0	.0	.1	.0	.0	.4
Total	178.1	6.2	9.1	2.1	0.1	7.3	202.9
Percent	87.8	3.1	4.5	1.0	0	3.6	100.00

Table 5.--Mean basal area per acre (ft^2) by tree condition, Bull Gap survey area

DIAMETER CLASS	LIVE STANDING	SNAG	STUB	STUMP	RECENT KILL	DEAD DOWN	TOTAL ALL CLASSES
6	14.2	.5	.5	.0	.0	.5	15.7
8	8.8	.0	1.1	.0	.0	1.1	11.0
10	11.0	.0	.0	.0	.0	.0	11.0
12	7.1	.0	.0	.0	.0	.0	7.1
14	7.7	1.1	.5	.0	.0	.0	9.3
16	10.4	.0	.0	.0	.0	.0	10.4
18	12.6	.5	.5	1.1	.0	1.9	16.6
20	8.8	.0	.5	.0	.0	.0	9.3
22	13.2	.0	1.1	.0	.0	.0	14.3
24	12.6	.5	.5	.0	.0	.0	13.6
26	12.6	1.1	1.1	1.1	.0	.0	15.9
28	12.1	1.6	2.3	1.1	.0	1.1	18.2
30	8.2	.5	.5	1.9	.0	.0	11.1
32	8.2	1.1	.0	.5	.0	.0	9.8
34	10.4	1.6	.5	.5	.5	.5	14.0
36	7.7	1.1	.0	.0	.0	.5	9.3
38	6.0	1.1	.5	1.1	.0	.0	8.7
40	5.5	.0	1.6	.5	.0	.0	7.6
42	4.9	.5	.5	1.1	.0	.0	7.0
44	2.2	1.1	.5	.0	.0	.0	3.8
46	7.7	.5	.5	.0	.0	.0	8.7
48	1.6	.5	1.1	.0	.0	.5	3.7
50	5.5	.0	.0	.0	.0	.0	5.5
52	4.4	.0	.0	.5	.0	.0	4.9
54	2.2	1.1	.0	.0	.0	.0	3.3
56	2.2	.5	.0	.5	.0	.0	3.2
58	1.1	.5	.5	.0	.0	.0	2.1
60+	6.6	.0	.0	1.1	.0	.0	7.7
TOTAL	215.5	15.4	14.3	11.0	0.5	6.1	262.8
PERCENT	82.8	5.9	5.4	4.2	0.2	2.3	100.0

Table 6.--Mean volume per acre (Mbdft) by tree condition, Bull Gap survey area

DIAMETER CLASS	LIVE STANDING	SNAG	STUB	STUMP	RECENT KILL	DEAD DOWN	TOTAL ALL CLASSES
8	.4019	.0000	.0502	.0000	.0000	.0502	.5023
10	.7233	.0000	.0000	.0000	.0000	.0000	.7233
12	.6893	.0000	.0000	.0000	.0000	.0000	.6893
14	.9616	.1374	.0687	.0000	.0000	.0000	1.1677
16	1.5956	.0000	.0000	.0000	.0000	.0000	1.5956
18	2.2964	.0998	.0998	.1997	.0000	.2996	2.9953
20	1.6476	.0000	.1030	.0000	.0000	.0000	1.7506
22	2.5855	.0000	.2155	.0000	.0000	.0000	2.8010
24	2.7359	.1190	.1190	.0000	.0000	.0000	2.9739
26	2.9670	.2580	.2580	.2580	.0000	.0000	3.7410
28	3.0616	.4175	.4175	.2783	.0000	.2783	4.4532
30	2.1483	.1432	.1432	.4297	.0000	.0000	2.8644
32	2.2001	.2933	.0000	.1467	.0000	.0000	2.6401
34	3.0019	.4740	.1580	.1580	.1580	.1580	4.1079
36	2.3865	.3409	.0000	.0000	.0000	.1705	2.8979
38	1.8949	.3445	.1723	.3445	.0000	.0000	2.7562
40	1.7443	.0000	.5232	.1744	.0000	.0000	2.4419
42	1.6838	.1871	.1871	.3742	.0000	.0000	2.4322
44	.8058	.4029	.2014	.0000	.0000	.0000	1.4101
46	3.0011	.2144	.2144	.0000	.0000	.0000	3.4299
48	.6550	.2183	.4367	.0000	.0000	.2183	1.5283
50	2.2323	.0000	.0000	.0000	.0000	.0000	2.2323
52	1.8812	.0000	.0000	.2351	.0000	.0000	2.1163
54	1.0066	.5034	.0000	.0000	.0000	.0000	1.5100
56	.9841	.2460	.0000	.2460	.0000	.0000	1.4761
58	.5238	.2619	.2619	.0000	.0000	.0000	1.0476
60+	3.1493	.0000	.0000	.5250	.0000	.0000	3.6743
TOTAL	48.9647	4.6616	3.6299	3.3696	.1580	1.1749	61.9587
PERCENT	79.0	7.5	5.9	5.4	.3	1.9	100.0

Table 7.--Mean number of trees per acre affected by each pathogen encountered in Bull Gap survey

DIAMETER CLASS	DWARF MISTLETOE	*A. MELLEA*	*P. WEIRII*	MISC. DECAYS	*G. LIBOCEDRI*	BLISTER RUST	TOTAL ALL CLASSES
6	11.2	.0	.0	8.4	.0	.0	19.6
8	3.1	1.5	.0	4.7	.0	.0	9.3
10	4.0	.0	.0	.0	.0	.0	4.0
12	2.1	.0	.0	.0	.0	.0	2.1
14	3.1	.0	.0	.0	.0	.0	3.1
16	2.4	.0	.0	.4	.0	.0	2.8
18	3.1	.0	.9	.6	.0	.0	4.6
20	1.5	.0	.0	.3	.0	.0	1.8
22	2.1	.0	.0	.4	.4	.0	2.9
24	3.0	.5	.0	.2	.0	.0	3.7
26	2.4	.0	.0	.4	.1	.0	2.9
28	1.9	.3	.3	.5	.1	.0	3.1
30	1.1	.0	.0	.1	.0	.0	1.2
32	.9	.1	.0	.0	.0	.0	1.0
34	.9	.0	.1	.2	.2	.0	1.4
36	.8	.1	.0	.0	.1	.0	1.0
38	.4	.1	.0	.1	.0	.0	.6
40	.3	.1	.0	.1	.0	.0	.5
42	.2	.0	.0	.1	.1	.0	.4
44	.1	.0	.0	.1	.0	.0	.2
46	.3	.0	.0	.0	.0	.1	.4
48	.1	.0	.0	.1	.0	.0	.2
50	.2	.0	.0	.0	.0	.0	.2
52	.1	.0	.0	.0	.0	.0	.1
54	.0	.0	.0	.0	.0	.0	.0
56	.1	.0	.0	.0	.0	.0	.1
58	.0	.0	.0	.1	.0	.0	.1
60	.1	.0	.0	.0	.0	.0	.1
TOTAL	45.5	2.7	1.3	16.8	1.0	0.1	67.4
PERCENT OF STAND TOTAL	22.5	1.3	0.6	8.3	0.5	0.0	33.3

Table 8.--Mean basal area per acre (ft^2) affected by each pathogen encountered in Bull Gap survey

DIAMETER CLASS	DWARF MISTLETOE	*A. MELLEA*	*P. WEIRII*	MISC. DECAYS	*G. LIBOCEDRI*	BLISTER RUST	TOTAL ALL CLASSES
6	2.2	.0	.0	1.6	.0	.0	3.8
8	1.1	.5	.0	1.6	.0	.0	3.2
10	2.2	.0	.0	.0	.0	.0	2.2
12	1.6	.0	.0	.0	.0	.0	1.6
14	3.3	.0	.0	.0	.0	.0	3.3
16	3.3	.0	.0	.5	.0	.0	3.8
18	5.5	.0	1.7	1.1	.0	.0	8.3
20	3.3	.0	.0	.5	.0	.0	3.8
22	5.5	.0	.0	1.1	1.3	.0	7.9
24	9.2	1.9	.0	.5	.0	.0	11.6
26	8.8	.0	.0	1.6	.5	.0	10.9
28	8.2	1.1	1.1	2.2	.5	.0	13.1
30	5.5	.0	.0	.5	.0	.0	6.0
32	4.9	.5	.0	.0	.0	.0	5.4
34	5.5	.0	.5	1.1	1.1	.0	8.2
36	5.5	.5	.0	.0	.5	.0	6.5
38	3.3	.5	.0	.5	.0	.0	4.3
40	2.7	.5	.0	.5	.0	.0	3.7
42	1.6	.0	.0	.5	.5	.0	2.6
44	1.1	.0	.0	.5	.0	.0	1.6
46	3.3	.0	.0	.5	.0	.6	4.4
48	1.1	.5	.0	1.1	.0	.0	2.7
50	2.2	.0	.0	.0	.0	.0	2.2
52	1.6	.0	.0	.0	.0	.0	1.6
54	.0	.0	.0	.0	.0	.5	.5
56	1.1	.0	.0	.5	.0	.0	1.6
58	.0	.0	.0	1.1	.0	.0	1.1
60+	2.7	.0	.0	.5	.0	.0	3.2
TOTAL	96.3	6.0	3.3	18.0	4.4	1.1	129.1
PERCENT OF STAND TOTAL	36.7	2.3	7.3	6.9	1.7	0.4	49.2

Table 9.--Mean volume per acre (Mbdft) affected by each pathogen encountered in Bull Gap survey

DIAMETER CLASS	DWARF MISTLETOE	*A. MELLEA*	*P. WEIRII*	MISC. DECAYS	*G. LIBOCEDRI*	BLISTER RUST	TOTAL ALL CLASSES
8	.0502	.0251	.0000	.0753	.0000	.0000	.1506
10	.1447	.0000	.0000	.0000	.0000	.0000	.1447
12	.1591	.0000	.0000	.0000	.0000	.0000	.1591
14	.4121	.0000	.0000	.0000	.0000	.0000	.4121
16	.5039	.0000	.0000	.0840	.0000	.0000	.5879
18	.9984	.0000	.2996	.1997	.0000	.0000	1.4977
20	.6179	.0000	.0000	.1030	.0000	.0000	.7209
22	1.0773	.0000	.0000	.2155	.2155	.0000	1.5083
24	2.0222	.3569	.0000	.1190	.0000	.0000	2.4981
26	2.0640	.0000	.0000	.3870	.1290	.0000	2.5800
28	2.0870	.2783	.2783	.5565	.1392	.0000	3.3393
30	1.4322	.0000	.0000	.1432	.0000	.0000	1.5754
32	1.3201	.1467	.0000	.0000	.0000	.0000	1.4668
34	1.5800	.0000	.1580	.3160	.3159	.0000	2.3699
36	1.7046	.1705	.0000	.0000	.1705	.0000	2.0456
38	1.0336	.1723	.0000	.1723	.0000	.0000	1.3782
40	.8722	.1744	.0000	.1744	.0000	.0000	1.2210
42	.5613	.0000	.0000	.1871	.1871	.0000	.9355
44	.4029	.0000	.0000	.2014	.0000	.0000	.6043
46	1.2862	.0000	.0000	.2144	.0000	.2144	1.7150
48	.4367	.2183	.0000	.4367	.0000	.0000	1.0917
50	.8929	.0000	.0000	.0000	.0000	.0000	.8929
52	.7054	.0000	.0000	.0000	.0000	.0000	.7054
54	.0000	.0000	.0000	.0000	.0000	.2516	.2516
56	.4921	.0000	.0000	.2460	.0000	.0000	.7381
58	.0000	.0000	.0000	.5238	.0000	.0000	.5238
60	1.3123	.0000	.0000	.2625	.0000	.0000	1.5748
TOTAL	24.1693	1.5425	.7359	4.6178	1.1572	.4660	32.6887
PERCENT OF STAND TOTAL	39.0	2.5	1.2	7.5	1.9	0.8	52.8